

FOREWORD

Use of the DOE Seismic Evaluation Procedure

The guidance provided in the DOE Seismic Evaluation Procedure must be used with the appropriate training and judgment as discussed throughout the Procedure. Before applying the methodology in this Procedure, the reference material for the SQUG GIP should be carefully studied. The methodology is not a “cookbook” approach because it requires an extensive use of judgment and a thorough understanding of the basis for the methodology. If differences are not marked appropriately in the sections of the DOE Seismic Evaluation Procedure which are taken directly or modified from the SQUG GIP, then the corresponding information in the SQUG GIP should be followed.

Engineers who use the DOE Seismic Evaluation Procedure are responsible for its appropriate application, their level of training, and their use of judgment. The developers of the Procedure assume no responsibility for specific applications of the methodology.

Peer review is a vitally important component of seismic evaluations of equipment and distribution systems at DOE facilities. The evaluation procedures described in the DOE Seismic Evaluation Procedure involve an extensive use of engineering judgment. This type of judgment must be independently reviewed to ensure that significant details are not overlooked or improperly evaluated.

Differences Between DOE Seismic Evaluation Procedure and the SQUG (Industry) GIP

As listed in the table following this discussion, the DOE Seismic Evaluation Procedure expands the SQUG GIP by incorporating DOE-specific requirements and guidance and by broadening the application of the experience-based methodology to equipment classes not contained in the SQUG GIP. The DOE Seismic Evaluation Procedure does not modify the technical content or numerical values of the equipment classes and anchorage procedure provided in the SQUG GIP, except where appropriately marked and referenced.

An attempt was made in the development of the DOE Seismic Evaluation Procedure to eliminate repetition in the SQUG GIP in order to make the procedure less cumbersome. This is most dramatically evidenced in Chapter 6 on anchorage and in Chapter 13 on documentation. Caveats for the Reference Spectrum and/or GERS were removed from the equipment evaluations in Chapter 8 that duplicate the requirements of Chapter 6 on anchorage, Chapter 7 on seismic interaction, or Chapter 11 on relays. The intent of these caveats is met by satisfying the procedures in Chapters 6, 7, and 11.

Throughout the DOE Seismic Evaluation Procedure, nuclear power plant and NRC-specific requirements and commitments from the SQUG GIP were removed and replaced with DOE facility information. Several of the sections in the DOE Seismic Evaluation Procedure reflect DOE guidance and standards and are considerably different than equivalent sections in the SQUG GIP. These sections have generic changes in order to integrate the experience-based methodology with DOE Orders and Standards. Portions of Chapters 1 and 3 on the DOE use of experience-based criteria, Chapter 4 on the Seismic Equipment List, Chapter 5 on comparing seismic capacity to demand, and Chapter 7 on seismic interaction were modified to reflect DOE provisions.

The DOE Seismic Evaluation Procedure has three major adaptations for non-reactor applications:

- In the SQUG GIP, the "40-foot rule" permits the use of the Bounding Spectrum to define the capacity for equipment with fundamental frequencies greater than about 8 Hertz and mounted within 40 feet above effective grade. The Bounding Spectrum has a generic deamplification of 1.5 as compared to the Reference Spectrum and is a simplified way for reducing the experience-based capacity to account for in-structure amplification. Since the "40-foot rule" was developed for nuclear power plants with massive and stiff shear wall structures that are not the typical structural types at DOE facilities, the DOE Seismic Evaluation Procedure does not have the "40-foot rule" or the Bounding Spectrum. Instead, the DOE approach uses the Reference Spectrum to define equipment capacity and to compare with in-structure response spectra developed at equipment locations.
- The DOE Seismic Evaluation Procedure has equipment classes that are not in the SQUG GIP. Chapter 10 on equipment class evaluations using screening procedures and general guidelines contains the additional equipment classes. Further information on the classes of equipment in Chapter 10 is provided in Sections 2.1.3.4 and 2.1.3.4.4.
- The relay review for DOE facilities contained in Chapter 11 focuses primarily on identifying low ruggedness relays and comparing seismic capacity to demand. The detailed procedure which is required for relay functionality reviews in nuclear power plants is not included in the DOE Seismic Evaluation Procedure.

As the SQUG GIP is revised, the appropriate modifications will be made to the DOE Seismic Evaluation Procedure. Currently, Revision 3 of the SQUG GIP (Ref. 4) is being reviewed by the NRC. Modifications have been made for expansion anchor capacity reduction factors in Table 6.3-5 and for panel amplification factors in Table 11.3-1 of the DOE Seismic Evaluation Procedure.

The following table lists the sections of the DOE Seismic Evaluation Procedure that contain information from Part II of Revision 2 of the SQUG GIP. In some cases, the section in the DOE Seismic Evaluation Procedure is considerably different than the section(s) from the SQUG GIP. For the DOE Seismic Evaluation Procedure sections listed below, footnotes appear in the document that identify the corresponding SQUG GIP sections. All the tables and figures from the SQUG GIP are also identified in the DOE Seismic Evaluation Procedure. In the table below, modifications (Mod.) from the appropriate sections of the SQUG GIP are denoted in these sections of the DOE Seismic Evaluation Procedure with *words in italics*.

**Relationship of Sections in the DOE Seismic Evaluation Procedure
and the SQUG GIP**

| Section in DOE Seismic Evaluation Procedure | Mod. | Section(s) from the SQUG GIP |
|--|------|---|
| 1.3 | | Section 1.2 |
| 2.1 | | Sections 1.3, 3.3, 4.0, 4.2, 4.3, 4.4 and 4.5 |
| 2.3 | | Appendices E and F |
| 3.1 | | Section 2.0 |
| 3.2 | | Section 2.4 |
| 3.3 | | Sections 2.2, 2.3, and 2.5 |
| 5.3 | | Section 4.2 |
| 5.4 | | Section 4.2 |
| 6. | | Section 4.4 and Appendix C |
| 7.1 | | Section D.1 |
| 7.2 | | Sections D.2, D.3, D.4, and D.6 |
| 7.5 | | Section D.5 |
| 8.1.1 | * | Section B.15 |
| 8.1.2 | * | Section B.1 |
| 8.1.3 | * | Section B.2 |
| 8.1.4 | * | Section B.3 |
| 8.1.5 | * | Section B.14 |
| 8.1.6 | * | Section B.4 |
| 8.1.7 | * | Section B.16 |
| 8.1.8 | * | Section B.20 |
| 8.1.9 | * | Section B.18 |
| 8.1.10 | * | Section B.19 |
| 8.2.1 | * | Section B.7 |
| 8.2.2 | * | Section B.8 |
| 8.2.3 | * | Section B.5 |
| 8.2.4 | * | Section B.6 |
| 8.2.5 | * | Section B.11 |
| 8.2.6 | * | Section B.12 |
| 8.2.7 | * | Section B.13 |
| 8.2.8 | * | Section B.17 |
| 8.2.9 | * | Section B.10 |
| 8.2.10 | * | Section B.9 |
| 9.1.1 | * | Sections 7.2, 7.3, 7.5, and 7.6 |
| 9.1.2 | * | Sections 7.2, 7.4, 7.5, and 7.6 |
| 9.2.1 | * | Sections 8.0, 8.2, 8.3, 8.4, and 8.5 |
| 11.2 | | Section 6.4 |
| 11.3 | | Section 6.4 |
| 11.4 | | Section 6.5 |
| 11.5 | | Section 6.6 |

**Relationship of Sections in the DOE Seismic Evaluation Procedure
and the SQUG GIP (Continued)**

| Section in DOE Seismic Evaluation Procedure | Mod. | Section(s) from the SQUG GIP |
|--|------|------------------------------|
| 12.1 | | Section 5.0 |
| 12.2 | | Section 5.2 |
| 12.3 | | Section 5.3 |
| 12.4 | | Section 5.4 |
| 13.1 | | Section 9.0 |
| 13.2 | | Appendix G |
| 13.3 | | Section 4.6 |
| 13.4 | | Section 9.4 |
| 14. | | Section 10 |

Acronyms Used in the DOE Seismic Evaluation Procedure

| | |
|------------------|---|
| AF | in-cabinet Amplification Factor |
| DBE | Design Basis Earthquake |
| DOE | United States Department of Energy |
| EPRI | Electric Power Research Institute |
| ESER | Equipment Seismic Evaluation Report |
| F _{ED} | Experience Data Factor |
| GERS | Generic Equipment Ruggedness Spectrum |
| GIP | Generic Implementation Procedure |
| IDS | In-cabinet Demand Spectrum |
| IRS | In-structure Response Spectrum |
| LANL | Los Alamos National Laboratory |
| LLNL | Lawrence Livermore National Laboratory |
| NEHRP | National Earthquake Hazards Reduction Program |
| NRC | Nuclear Regulatory Commission |
| OSSES | Outlier Seismic Evaluation Sheets |
| P _{all} | Allowable pullout capacity of installed anchors |

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|-----------|---|
| PC | Performance Category |
| Sa_i | Spectral acceleration at frequency f_i |
| SAR | Safety Analysis Report |
| SCE | Seismic Capability Engineer |
| SDS | Seismic Demand Spectrum |
| SEDS | Screening Evaluation and Data Sheets |
| SEL | Seismic Equipment List |
| SEWS | Screening Evaluation Work Sheets |
| SF | Scale Factor |
| SQUG | Seismic Qualification Utility Group |
| SRS | Savannah River Site |
| SRT | Seismic Review Team |
| SSC | Structure, Systems, and Component |
| SSRAP | Senior Seismic Review and Advisory Panel |
| STD | Standard |
| UBC | Uniform Building Code |
| USI | Unresolved Safety Issue |
| V_{all} | Allowable shear capacity of installed anchors |
| ZPA | Zero Period Acceleration |